Genome 371; A 03
Berg/Brewer
Practice Exam I; Wednesday, Oct 15, 2003

PRACTICE EXAM GENOME 371 Autumn 2003

These questions were part of the first exam from Autumn 2002.

Take the exam in a quiet place and only when you are sure you will have time to complete the exam uninterrupted. Time yourself. This exam should require about 50 minutes to complete.

If you print this exam on a black and white printer, you will need to go to the course web page to view the cats discussed in question 5.

X^2 table

P	0.995	0.975	0.900	0.500	0.100	0.050	0.025	0.010	0.005
df									
1	0.000	0.000	0.016	0.455	2.706	3.841	5.024	6.635	7.879
2	0.010	0.051	0.211	1.386	4.605	5.991	7.378	9.210	10.597
3	0.072	0.216	0.584	2.366	6.251	7.815	9.348	11.345	12.838
4	0.207	0.484	1.064	3.357	7.779	9.488	11.143	13.277	14.860
5	0.412	0.831	1.610	4.351	9.236	11.070	12.832	15.086	16.750
6	0.676	1.237	2.204	5.348	10.645	12.592	14.449	16.912	18.548

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1) (16 pts) You are studying plant height in a new strain of peas. You let a plant of moderate height self pollinate and grow up the progeny of this cross. You discover the following heights and numbers among the 96 offspring of the self-cross:

19 Tall 54 Moderate 23 Dwarf

A) If this trait were determined by a single gene, what genetic principle does this cross illustrate?

_____

What is the expected ratio for this hypothesis? _____

Give the genotype of the moderate plant and possible genotypes for the offspring.

Moderate Parent: _____

Offspring: Tall: _____ Dwarf: _____

B) If this trait were determined by two genes, what genetic principle does this cross illustrate?

_____

What is the expected ratio for this hypothesis? _____

Give the genotype of the moderate plant and possible genotypes for the offspring.

Moderate Parent: _____

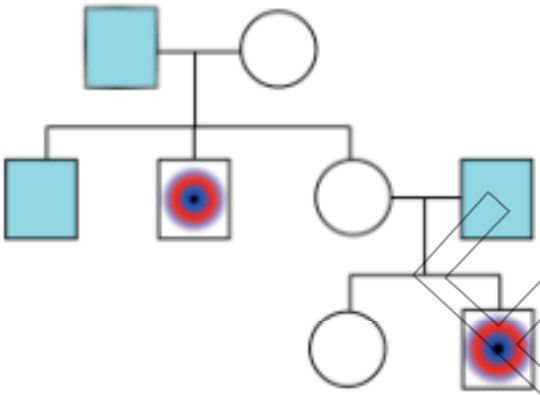
Offspring: Tall: _____ Dwarf: _____

C) Below are the X^2 values for each hypothesis. What are the P values for each hypothesis? Is either hypothesis rejected by the data? (A X^2 table is on the cover page of the exam.)

Hypothesis	X^2 value	P value	Accept/Reject?
"one" gene	1.83	between _____ and _____	
"two" genes	0.097	between _____ and _____	

D) What experiment would you do to distinguish between the two hypotheses? Include the expected results.

2) (12 pts) There are two sex-linked traits segregating in the family shown below. (The pedigree is repeated below for your convenience.) For this question, ignore complications arising from biased X-chromosome inactivation.



A). Is  a dominant or recessive trait? _____

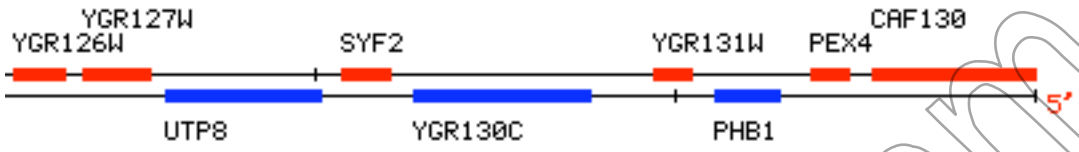
Use X^A and X^a to indicate genotypes for this trait. What is the genotype of  ?_____

B) Is  a dominant or recessive trait? _____

Use X^B and X^b to indicate genotypes for this trait. What is the genotype of  ? _____

C) Assume the A and B loci are closely linked to one another. What is the genotype of III-1?

3) (7 pts) Below is a portion of the yeast genome as displayed in the Saccharomyces data base (SGD). The gene of interest is UTP8. Deduce the answers to the following questions about this gene by looking at this diagram.



A. What would be the systematic name of UTP8? _____

B. What chromosome is UTP8 on? _____

C. In which direction from UTP8 (left or right) would the centromere be found? _____

D. On which side of UTP8 (left or right) would you find UTP8's promoter? _____

E. In what direction (left or right) would RNA polymerase move to make UTP8 mRNA? _____

F. Which strand (watson or crick) would RNA polymerase use as template to make the message for UTP8?
_____

G. On the map above draw an arrow to the specific place where the ATG codon for UTP8 would be found.

4) (25 pts) Wanting to follow in Beadle and Tatums's footsteps, Sue decided to genetically dissect the pathway of vitamin B12 synthesis in her favorite haploid organism, yeast.

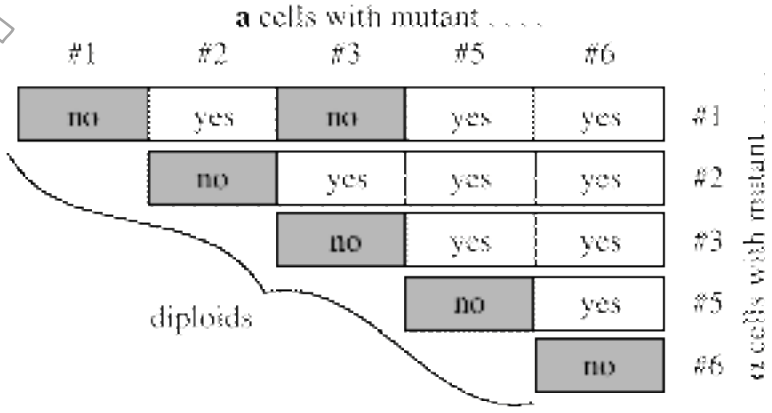
First she isolated lots of mutants (6 mutants) that all required vitamin B12 to be present in the medium in order for the cells to grow. Then she crossed them all individually to wild type yeast and plated on plates that lacked vitamin B12. Here are her results:

haploid mutant number	growth of heterozygous diploid without B12?
#1	yes
#2	yes
#3	yes
#4	no
#5	yes
#6	yes

A. What did these results tell Sue about each of her mutants?

Sue then crossed some of her mutants in pair-wise combinations and tested their growth on -B12 plates. Here are her results: ("yes" and "no" refer to whether the diploid was able to grow in the absence of vitamin B12.)

B. What did these results tell Sue?

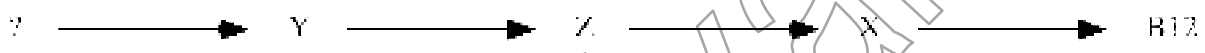


Sue then tried growing her 6 different mutants on plates that lacked vitamin B12 but contained one of several different intermediates in the B12 pathway. She called them compounds X, Y and Z.

C. Sue's biochemist friend said that the intermediates are converted into vitamin B12 in the order shown below. Do Sue's mutant data support the biochemist's hypothesis?

Yes_____ No _____ Not exactly _____

□ cells with mutant	growth on medium lacking vitamin B12 but containing X	Y	Z
#1	yes	no	no
#2	yes	yes	yes
#3	yes	no	no
#4	yes	no	yes
#5	no	no	no
#6	yes	yes	yes



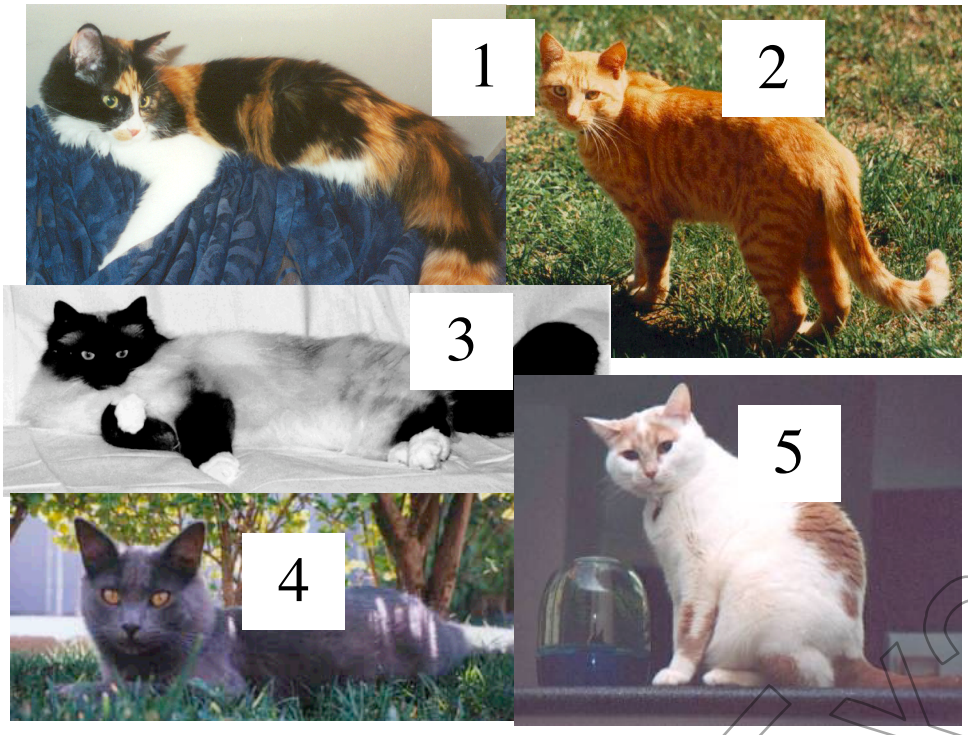
If **yes**, indicate on the pathway above, the steps catalyzed by each of the gene produces (1-6) identified by Sue.

If **no**, draw your own pathway.

If **not exactly**, where do the biochemical and genetic data disagree? How would you modify the biochemist's hypothesis? Answer these questions and then modify the diagram above to reflect this change. Are there still unresolved issues about the pathway? If so, what are they.

D. What specific hypothesis can you make about the structure of the enzyme encoded by the gene that is mutant in strain #4?

6) (20 pts) Assume all of the cats in the composite photo are homozygous **UNLESS** there is something about their appearance that would lead you to believe otherwise. Further assume that you would have access to cats of either sex for each type, **UNLESS** there is something about their appearance that would lead you to believe otherwise.



Phil wants to generate a male cat that is a long-haired Siamese with orange pigmentation on the face, ears, feet and tail instead of the normal black coloration in these areas.

A. What would be the genotype of such a male cat? Indicate indifferent alleles by a question mark (?).

A locus	B locus	C locus	D locus	I locus	L locus	O locus	S locus
??	B?		D?	ii			

B. Would it be possible to generate the desired male cat in a single generation, starting with any pair of the cats shown above?

Yes _____ (see below) No _____ (see part C)

If yes, what two cats should Phil cross? Show their genotypes and the gametes they would need to produce to generate the desired genotype (for C, L, O, and S loci) of the long-haired, male orange Siamese.

What are the chances of coming up with the desired kitten in this first generation?

C. If you answered no to part B, could Phil get a cat of the desired phenotype in the second generation?

Yes _____ No _____

If yes, which cats should Phil start with? Give cat numbers (1-5) and pertinent genotypes (for C. L. O. and S loci).

What first generation kittens (male and female) will be used to get the second generation? Give pertinent genotypes of these kittens.

What are the gametes the first generation kittens would need to produce to create the long-haired, male orange Siamese in the second generation:

What are the chances of coming up with the desired kitten in this second generation?